**Low Temperature Thermal Desorption Design**
**Former Drum Storage Area**
**Methode Electronics, Inc.**
**Harwood Heights, Illinois**
**LPC No. 031110002 – Cook County**
**US EPA ID No. ILD005092135**

Prepared for
**Methode Electronics, Inc.**
7444 West Wilson Avenue
Chicago, Illinois

HLA Project No. 42331,1

Jeff C. Rudolph
Jeff C. Rudolph
Project Engineer

S. C. Anderson
Steven C. Anderson, CHMM
Senior Geologist

October 5, 1998

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PERMIT SECTION

**Harding Lawson Associates**
Engineering and Environmental Services
The Crossings, 1420 Kensington Road, Suite 213
Oak Brook, IL 60523 - (630) 571-2162

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# 1.0 INTRODUCTION

This report presents the low temperature thermal desorption design plan for the former hazardous waste management units (HWMUs) located at the Methode Electronics, Inc. (Methode) facility (hereafter referred to as "the site") at 7444 West Wilson Avenue in Harwood Heights, Illinois (Figure 1). This design plan has been prepared for the closure of the HWMU's in compliance with interim status as described in Part 725, Title 35, Subtitle G of the State of Illinois Administrative Code (IAC). This submittal is required since Methode has elected to conduct onsite remediation of soils through the use of Low Temperature Thermal Desorption (LTTD). This document has been prepared in accordance with Illinois Environmental Protection Agency (IEPA) guidance dated June 1995 and September 1998.

To obtain early concurrence on the contents of this report, a draft outline was prepared by Harding Lawson Associates (HLA) and submitted to Mr. Jim Moore and Mr. Munib Ahmad of IEPA via facsimile on September 18, 1998. Mr. Moore approved this outline in a telephone conversation with Mr. Steve Anderson of HLA on that date.

## 1.1 Purpose

Per an IEPA request (IEPA, 1998) this report presents the design to conduct LTTD remediation at the Site. As delineated by the IEPA, the goal of this project is to address shallow soil impacts above the soil saturation limit in the vicinity of CS-9 through CS-13. Specifically, this report provides a description of and technical specifications for the LTTD unit to be used at the site. A closure cost estimate and a project schedule are also presented in this report.

## 1.2 Site Conditions

### 1.2.1 Site Description

Methode manufactured printed circuit boards at its facility located at 7444 West Wilson Avenue, Harwood Heights, Illinois until June 1981. After discontinuing the printed circuit operation, Methode began assembling circuits from purchased components, utilizing printed polymers to produce additive circuitry and its components. The facility is situated on an approximately 170,000 square-foot lot, at the Northeast 1/4 of Section 13, Township 40 North, Range 12 East. Historically, Methode had maintained several areas for storing hazardous wastes at its facility. These areas include the East Plant Circuit Board Treatment Area (SO1), Gravel Lined Storage Area (SO1), Drum Storage Slab (SO1), Drum Storage Shed

(SO1), Tank Slab (SO2), West Plant Circuit Board Treatment Area (three tank storage areas [SO2] and two treatment tank areas [TO1]). These areas were used to store drums of raw materials (including toluene, acetone, isopropyl alcohol and cutting oil) and hazardous wastes (including spent cyanide solutions from electroplating operations and spent halogenated and non-halogenated solvents). Spent halogenated solvent was also stored in an aboveground storage tank at the Tank Slab portion of the Storage Area. None of the areas are currently active.

### 1.2.2 Background

HLA (formerly Yates & Auberle, Ltd.) conducted initial surface soil sampling activities in November 1988. The results of this work were summarized in the Modified Facility Closure Plan (Yates & Auberle, 1989). IEPA responded to this document with a correspondence in February 1991 (IEPA, 1991), which established cleanup objectives (CUOs). In response to the IEPA February 1991 letter, HLA conducted additional shallow soil and soil gas sampling in 1991. The results of this work were summarized in HLA's report dated August 1991 (HLA, 1991).

In September 1992, HLA conducted an extensive soil sampling program to evaluate the vertical and horizontal extent of chemically-impacted soils and groundwater. Based on the soil type and concentration trends encountered, HLA estimated that the vast majority of volatile organic compounds (VOCs) were limited to within 20 feet below ground surface (bgs) near the East Plant Building. Significantly lesser amounts of VOCs are beneath the parking lot north of the East Plant Building, where they were limited to within 8 feet bgs. Groundwater was not encountered at depths as great as 17 feet. The results of the field investigation were submitted to the IEPA on December 1, 1992 in a report entitled "Closure Investigation" (HLA, 1992).

In February 1993, three additional soil borings were drilled to depths as great as 80 feet as part of a groundwater investigation. Groundwater was not encountered in these borings. Methode and HLA personnel met with the IEPA on February 24, 1993 to discuss the December 1, 1992 report and the investigation conducted in February 1993. Based on this meeting, IEPA issued a letter on March 2, 1993 which concluded there is currently no threat to groundwater and no additional hydrogeologic investigation is required. IEPA also required that Methode submit an evaluation of remedial alternatives. A report entitled "Evaluation of Remedial Alternatives" dated August 30, 1993 was submitted to the

IEPA. The report concluded that enhanced soil vapor extraction (SVE) was the selected site control alternative.

Additional site characterization work was conducted by O'Shea, Parsons & Associates, Inc. (OPA) in January and February 1995 (OPA, 1995). Subsequently, in response to a report titled "Environmental Impact Modeling and Risk Assessment in support of Alternative Clean-Up Objectives" dated March 28, 1995, the IEPA issued revised cleanup objectives for the Site in a correspondence dated July 28, 1995 (IEPA, 1995).

Subsequent to this, a process known as six-phase soil heating (SPSH) was adopted as the selected remedial alternative at the Site. With this technology, electricity is used to resistively heat soils as an enhancement to SVE. SPSH uses conventional single-phase transformers to convert standard three-phase electricity into six-phase electricity. Electrodes are inserted into the ground in one or more hexagonal arrays with six electrodes per array. Each of the six electrodes is connected to a separate transformer to provide it with a separate current phase. These electrodes also serve as vapor recovery vents during operations. An additional, "neutral" electrode located at the center of the array, acts as the main vent. The hexagonal shape electrode array was chosen because it provides a more uniform distribution of electrical currents in the soil than other geometries.

The estimated time-frame required for the SPSH process to reach remediation goals for an array was approximately one to two months for this Site (Terra Vac and Battelle, 1996). Five arrays were utilized at the Methode facility. In the Final Design Report for this remedial method Terra Vac and Battelle, Pacific Northwest Laboratory stated that based upon previous investigations and the IEPA CUOs the volume of soils identified for remediation is estimated to be 6,400 cubic yards.

The SPSH was installed in fall 1996 and Array 1 went on line on October 9,1996. The SPSH transformer was taken off line June 2, 1997. Reportedly, operation of the SVE system continued until approximately October 1, 1997. Soil sampling was conducted by Terra Vac during system operation and reported to the IEPA in Quarterly Reports. Follow-up soil sampling was conducted by HLA on October 22-24, 1997, the results of which are included in a report entitled RCRA Closure Sampling Report dated March 5, 1998.

In the HLA study, PCE concentrations ranged from non-detect to a maximum detection of 68,700 mg/kg at CS-10 from 1 to 2 feet bgs, and TCE concentrations ranged from non-detect to 126 mg/kg in CS-10 from 9 to 10 feet bgs. HLA estimated the soil volume still exceeding the 1995 IEPA CUOs as 2,600 cubic yards. IEPA responded to the report in a correspondence dated August 5, 1998. The report delineated eight items for closure of the Site including:

1. A Soil Investigation and Removal
2. A Site Survey
3. Installation of an Engineered Barrier
4. Delineation of Impacted Soils
5. Survey Plat Language
6. Deed Restriction Requirements
7. Submittal of Survey Plat to IEPA
8. Closure Certification

This design report responds to a portion of Item 1.

### 1.2.3 Geology

Physiography

The Methode facility is located approximately 2.5 miles east of the Des Plaines River and approximately three miles southwest of the North Branch of the Chicago River. The Des Plaines River is gently meandering and flowing south in this region.

The Methode facility is located on a topographic high with a surface elevation of approximately 650 feet above mean sea level; the regional relief is approximately 10 feet.

Regional Geology

The unconsolidated deposits identified in the region are Pleistocene glacial deposits overlying Silurian bedrock. The total thickness of the unconsolidated deposits is an estimated 100 to 150 feet (Hughes et al., 1966). The surficial glacial deposits consist of glacial till of the Wedron Formation deposited during the Wisconsinan glacial stage. Till members of the Wedron Formation are usually gray, rich in clay and silt with some sand and gravel. More precisely, the facility is located on the Park Ridge moraine of the Lake Border Morainic System of the Wadsworth till member (Willman, 1971). The Park Ridge Moraine consists of uniform, relatively impermeable silty clay, or other fine-grained material thicker than 50 feet with no identified sand and gravel deposits.

Regional well log data indicate that the basal part of this glacial drift directly overlying the bedrock contains a relatively extensive deposit of sand and gravel. The thickness of this basal unit is extremely variable, ranging from 1 to 50 feet (Prickett, et al, 1964). Generally, these deposits are thickest where total drift thickness is greatest.

Bedrock in the region consists of Silurian dolomite with a regional dip of about 10 feet per mile towards the east-southeast (Suter, et al, 1959). The Silurian dolomites are divided into Niagaran Series above and Alexandrian Series below. The combined thickness of these dolomites is fairly uniform and averages about 400 feet. (Suter, et al, 1959; Prickett, et al, 1964).

Regional Hydrogeology

The shallow dolomite aquifer system has historically been the chief source of groundwater in the region. Groundwater in the dolomite aquifer occurs in joints, fissures, and solution cavities, which are irregularly distributed both areally and with respect to depth. Groundwater in the dolomite aquifer occurs under (i) leaky artesian conditions where fine-grained deposits overlie the dolomite and at some instances under (ii) water-table conditions where the upper surface of the zone of saturation is in the dolomite within deep zones of depression created by heavy pumping and water is unconfined (Prickett, et al, 1964).

The average slope of piezometric surface in areas unaffected by the pumping is reported to be about 15 feet per mile for the Chicago heights area (Prickett, et al, 1964). The potentiometric surface maps of these shallow dolomites indicate that the regional groundwater flow is in the east-southeast direction (Suter, et al, 1959) (from the Methode site towards another manufacturing district).

It was concluded (Csallany and Walton, 1963) that the yield from the Silurian dolomite is greater in areas where sand and gravel directly overlie and are in hydraulic connection with the dolomite than it is in areas where relatively impermeable till directly overlies the dolomite.

Historically, extensive dewatering of upper portions of the Silurian dolomite has taken place in the region. The available data indicate that the average thickness of dewatered dolomite is about 36 feet in the Chicago Heights (approximately 30 miles from Methode) area and about 60 feet in the vicinity of LaGrange (approximately 10 miles from Methode). There is no readily available information for the Harwood

Heights area. The specific capacity data indicate that where extensive dewatering has occurred, the coefficient of transmissivity of the Silurian dolomite aquifer averages about 22,000 gpd/ft (gallons per day per foot) for the Chicago Heights area and about 30,000 gpd/ft for the LaGrange area (Prickett, et al, 1964).

Recharge to the Silurian dolomite aquifer occurs mostly as vertical leakage of water through unconsolidated deposits with local precipitation as its source. Using the past records of pumpage and water levels, the average rate of recharge in the Chicago Heights area was estimated to be about 225,000 gpd/square mile (i.e., 4.73 inches/year) whereas the average rate of recharge in the LaGrange area was estimated to be about 160,000 gpd/square mile (i.e., 3.34 inches/year) [Prickett, et al, 1964].

Based on available well logs, the average saturated thickness of the sand and gravel deposits between the bedrock and the upper till deposits varied from 35 feet in the Chicago Heights area to about 40 feet in the LaGrange area. The coefficient of transmissivity of these deposits has been estimated to be an average of 25,000 gpd/ft (Suter, et al, 1959).

Site Geology/Hydrogeology

In 1993, HLA drilled a total of 21 soil borings. Eighteen borings (B-1 through B-19) were completed to a depth of 15 to 17 feet bgs. Three borings were completed to depths of 21 to 80 feet below ground surface (bgs) (MW-1 to 40 feet bgs; MW-2 to 80 feet bgs; and MW-3 to 21 feet bgs).

Based on these soil borings it is estimated that material underlying the site consists of limestone gravel and silt backfill for approximately the first 3 feet bgs, and silty clay with some traces of sand and gravel in the remaining 3 to 80 feet bgs. The geology appears to be uniform throughout the area investigated (HLA, 1992).

Geotechnical data (HLA, 1992) indicate that the glacial till material is lean clay with sand (approximately 10 percent) and gravel (approximately 3 percent) with an average hydraulic conductivity of $1.3 \times 10^{-6}$ cm/sec, average moisture content of 18.3 percent, average dry density of 112.5 pounds per cubic feet (pcf), average porosity of 34 percent, average liquid limit of 32 percent and an average plastic limit of 17 percent.

Water was encountered during initial drilling of some borings. This water appears to be trapped under the asphalt in the thin, discontinuous zone of limestone aggregate. This zone is of limited vertical extent since it was not observed deeper than approximately 1.5 feet bgs, and limited laterally since it was not encountered to the north (B-16, B-17) and to the east (B-15, B-16, B-17) of the waste storage area (HLA, 1992).

Saturated sand or sandy units were not observed in any of the soil borings. One groundwater monitoring well was initially installed and screened at shallow depth (B-19) but the absence of water resulted in no further monitoring of this well. Borings advanced to greater depths (MW-1, MW-2, MW-3) were not developed into groundwater monitoring wells since no groundwater was encountered. Based on the relatively low hydraulic conductivity of glacial till/clay encountered at the site, the field observations, the continuity of the site geology and information on regional geology, it is unlikely that a permeable zone exists under the Site at a depth less than approximately 80 feet bgs.

# 2.0 SOIL REMEDIATION BY LOW TEMPERATURE THERMAL DESORPTION

## 2.1 Scope of Work

Methode will contract with $E^3$ Thermal Remediation ($E^3$) to conduct soil remediation using LTTD. HLA will provide independent construction oversight and coordinate activities required to begin operations at the site. References and brief descriptions for remediation projects which utilized $E^3$'s LTTD Indirect Heat Volatilization (IHV) Unit to remediate impacted soils are included in Appendix A.

$E^3$ will provide all permitting, labor, supervision, equipment, material and incidentals required to furnish, install, startup and operate a LTTD unit to remediate the VOC-impacted soils at the site. $E^3$ will perform the following tasks:

- Obtain all required permits to operate the LTTD unit;
- Supply and start up the LTTD unit at the site;
- Demonstrate the ability of the LTTD unit to remediate the soils at the site (through periodic analysis of treated soils) while complying with applicable regulations;
- Operate the LTTD unit, including the excavation and handling of the soils, to remediate the soils to the levels listed in Section 2.2;
- Backfill the excavated areas with treated soil; additional clean soil, if required, will be obtained from off-site sources;
- Provide and remove all temporary connections to utilities for the operation of the LTTD unit; and
- Provide all required notifications to the IEPA.

## 2.2 Definition of Remediation Objectives

IEPA's Tiered Approach to Corrective Action Objectives (TACO) rules establish procedures for developing remediation objectives for soil and groundwater at remediation sites based on risks to human health, taking into account the existing pathways for human exposure and current and future use of the remediation site. The methodology consists of a three tiered approach for establishing remediation objectives.

Each tier of the TACO process requires the applicant to considered up to four potential exposure routes for each contaminant of concern:

- Inhalation exposure route
- Soil ingestion exposure route
- Dermal contact exposure route (Tier 2 Risk Based Correction Action (RBCA) equations)
- Groundwater ingestion route

The groundwater ingestion route is further subdivided into two components: 1) the migration to groundwater, or soil component, which must be investigated to determine the soil remediation objective and 2) the direct ingestion of groundwater, or groundwater component which must be investigated to establish a groundwater remediation objectives. Outside of the individual tiers of analysis, there are two alternative means for assessing the presence of contamination: exclusion of pathway and reliance on area background. Exposure routes can be eliminated, if it can be demonstrated that the exposure route is not available or if one can rely on area background concentrations in establishing remediation objectives demonstrating that further remediation is not warranted.

Engineered barriers and institutional controls are key components of the TACO program, providing flexibility in developing practical risk-based remediation objectives. Engineered barriers limit exposure to or controls migration of the contaminants of concern. Institutional controls are put in place to assure long-term protection of human health while providing flexibility in developing practical risk-based remediation objectives.

As identified by the IEPA (IEPA, 1998) the main contaminants of concern at the Site are the volatile chlorinated solvents, tetrachloroethylene (PCE) and trichloroethene (TCE). The most stringent of the soil objectives for PCE and TCE is the soil component of the groundwater ingestion exposure route. The TACO Tier 1 Soil Objectives are shown below. The most stringent of the industrial/commercial soil objective associated with direct contact (ingestion or inhalation) is the inhalation exposure route. The cleanup objectives of 11 mg/kg and 9.0 mg/kg for PCE and TCE, respectively, previously supplied by IEPA are consistent with the most stringent residential soil objective for direct contact (inhalation).

| | *Industrial/Commercial (mg/kg)* | | *Construction (mg/kg)* | | *Soil to Groundwater (mg/kg)* | |
|---|---|---|---|---|---|---|
| CONSTITUENT | INHALATION | INGESTION | INHALATION | INGESTION | Class I | Class II |
| PCE | 20 | 110 | 28 | 2400 | 0.06 | 0.3 |
| TCE | 8.9 | 520 | 12 | 1,200 | 0.06 | 0.3 |

Under TACO, no exposure route can be excluded from consideration if it is determined that free product is present and has not been removed to the extent practicable. By definition, free product is present at the Site but in-situ remediation has been conducted to reduce the PCE and TCE soil concentrations to the limits of the remediation method, i.e., remediation to the extent practicable has been conducted. In this situation, both the inhalation exposure and soil ingestion exposure routes can be excluded from consideration if an engineered barrier, e.g., asphaltic concrete or the like, is in place. This requires safety precautions for the construction worker since the Tier I construction worker remediation objectives are exceeded.

Although, such an engineered barrier is recognized as a control of the soil component of the groundwater ingestion exposure route, specific criterion required for exclusion of the groundwater ingestion exposure pathway cannot be met. Specifically there is not an ordinance in place adopted by a unit of local government prohibiting the installation of potable water supply wells. However, Tier 2 assessment of the soil component of the groundwater exposure pathway can be conducted to demonstrate that the groundwater concentrations remaining in the soil would not exceed the Class I Groundwater Standard at the nearest downgradient domestic well. Equation R12 serves as the basis for deriving the Tier 2 remediation objective for the soil component of the groundwater exposure route using the RBCA approach.

Even though no groundwater has been encountered at 80 feet bgs and no groundwater plume has been detected, Equation R12 forms the basis for deriving Tier 2 remediation objectives for the soil component of the groundwater ingestion exposure route using the RBCA approach under TACO. The parameters, groundwater at the source ($GW_{source}$) and Leaching Factor ($LF_{sw}$) have numerical values that are calculated using Equations R13 and R14, respectively. Equation R13 requires numerical values that are calculated using Equation 15. Equation 14 requires numerical values that are calculated using Equations R21, R22 and R24. For TCE and PCE, the Soil Water Sorption Coefficient ($k_s$) were calculated using Equation R20. The remaining parameters in Equation R14 were site-specific values (HLA, 1993) or default values listed in Appendix B. The results of the RBCA Equations are also provided in the Appendix B.

Using a combination of default assumptions and site-specific information in the RBCA equations R-12 through R-24, the maximum PCE and TCE soil concentration yielding a hypothetical downgradient PCE and TCE concentrations less the Class I Groundwater Criteria (0.005 mg/L and 0.005 mg/L, respectively) was determined with the engineered barrier (Appendix B). The nearest well is located 2,000 feet southeast of the Site (HLA 1993) and it was assumed that this well was directly downgradient and being used for domestic purposes. It was assumed that the soil source length parallel to the downgradient pathway was 100 feet. A site-specific value of 1.2% for the fraction of organic carbon in soil was used (HLA, 1993). The other assumptions used in the RBCA calculations are shown in Appendix B. The PCE and TCE soil concentrations, under these conditions, were 1780 and 177 mg/kg, respectively.

| COMPOUND | SOIL OBJECTIVE-CAP (mg/kg) |
|---|---|
| PCE | 1,780 |
| TCE | 177 |

As can be seen from the table above, using the conservative scenario in the models that assumed groundwater at 80 feet, a groundwater plume equal to the source length (100 feet) and a domestic groundwater receptor downgradient at 2,000 feet of the finite soil source of PCE and TCE, soil concentrations up to 1,780 and 177 mg/kg of PCE and TCE, respectively, would not result in exceedences of the Class I Groundwater Objective. Therefore, PCE and TCE concentrations up to 1,780 mg/kg and 177 mg/kg, respectively can remain at the site with an asphaltic concrete covering without any impact to the hypothetical downgradient groundwater receptor.

## 2.3 Project Conditions

Hours of Operation

Methode operations will allow for LTTD operation 8-12 hours per day. $E^3$ currently anticipates operating the LTTD unit from approximately 7:00 a.m. to 6:00 p.m., Monday through Friday and possibly 8:00 a.m. through 6:00 p.m. on Saturday. Approximately 3 to 5 working days are estimated to be required to remediate the site soils, based on a soil feed rate of 25 tons per hour, and the area delineated for excavation in Figure 2.